CHAPTER IX

DESIGN ANALYSIS

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CHAPTER IX
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1. **GENERAL**. The requirements and procedures for the preparation of a project design analysis are contained in ER 1110-345-700. Basically this ER addresses the contents required in a final design analysis for Contract Plans and Specifications. Information in this chapter supplements ER 1110-345-700. Additional guidance on contents of design analysis for other phases of design in this document are in chapter XI that covers submission requirements and chapters II through VI for technical disciplines. The design analysis will consist of bound assemblies to define the project, and present functional and engineering criteria, design analysis computations, drawings, specifications and estimated costs. Copies of the cost estimate shall be furnished as specified in Chapter X. Contents in the design analysis shall be suitable for independent technical review, permanent record purposes, for use in adapting the design to other sites, and future re-evaluation and modification of the construction.

2. **PREPARATION**.

2.1 **Size and Layout**. The design analysis shall be produced by a word processor and letter quality printer (using 12 point size print). Hand printed, sketches, photographed material shall be scanned to form an electronic image in the design analysis. Generally material shall be prepared for reproduction on vertically oriented A4 metric, 210mm x 297 mm (8.3 inches x 11.7 inches) or standard 8 ½ x 11-inch sheet size when metric is not available. Larger sheets, A3 metric, 297 mm X 420 mm, folded to the prescribed size may be utilized when appropriate for drawings. All side margins will be 25 mm (1 inch) minimum to permit side binding and head-to-head duplication.

2.2 **Organization**. The design analysis for projects with more than one building or facility will be organized into volumes for each major facility with a title page and complete table of contents for each volume. The individual parts, chapters and sheets of the design analysis for each facility shall be numbered sequentially and bound under one cover (insofar as practicable) indicating the volume number (if more than one), the name of the facility, the name of the project if different, the project number, fiscal year, date of

publication, and the drawing and specification numbers assigned to the facility. Covers will be a durable material with information to indicate contents thereon.

2.3 **Classified Material**. Every effort will be made to prepare the design analysis as to permit it to be an unclassified document, with proper reference to sources of classified material. Design analyses containing classified material will be marked and handled in accordance with applicable security regulations.

2.4 **Design Calculations**. Design analysis shall be prepared in metric. Technical design analysis will be performed and checked by separate individuals. An independent technical review shall be accomplished in accordance with a design Quality Control Plan (QCP) The names or initials and registration of individuals performing the independent technical review will be indicated on the computation pages or a cover sheet for the calculations. Presentation will be clear and legible. The source of loading conditions, formulas, references and tabulation showing all design loads and conditions will be identified. Assumptions and conclusions will be explained and cross-referencing will be clear.

2.5 **Automated Data Processing**. When computer programs are used, the design analysis should include a complete listing of the input and output data, and calculations necessary for preparation of the input data. Input should be annotated to facilitate a reviewer's verification of data. Computer output should be in a format that identifies results by proper column headings and line identification keyed to a sketch of the structure if necessary. Voluminous output data may be included in a separate volume or, output presentation may be limited to key sections or to typical results when output is repetitive. Computer programs will be considered "approved" or "non-approved," where approval is subject to District approval for A-E designs. Approved programs will be those commonly used programs judged to be reliable and thoroughly debugged; examples of approved programs are BLAST, STRUDL and COGO. Non-approved programs are typically those written by an individual engineer to simplify repetitive computations. When non-approved programs are used the design analysis must include a description of the theories, assumptions and design methods employed, sufficient to verify validity of the

program. Non-approved programs will require a higher degree of input description and output verification.

2.6 **Standard Design**. Analyses for standard designs shall be prepared in accordance with the requirements of ER 1110-345-700 and applicable requirements in this chapter. Modifications of standard design analysis shall be accomplished to meet project site conditions as authorized by ER 1110-345-700.

2.7 **Other Data**. Codes, manuals, special investigations and reports are to be considered and used as applicable.

2.8 **Submission**. Except when specifically exempted, a design analysis will accompany all drawings submitted. The design analysis presented with preliminary or partially completed work will be as complete as the stage of design progress permits. Types of submittals along with a description of the required contents for that type are outlined in Chapter XI. Which of the types of submittals are required is stated in the A-E contract.

3. **FORMAT AND CONTENT**. The basic design analysis format for each phase of the design (Air Force Project Definition, Army Project Engineering, Army Concept, Army and Air Force Charette, Preliminary, Final, and Corrected Final) are essentially the same, adjusted for the particular level of design and the type of facility. The following pages present the format to be used in the preparation of the Design Analysis for each discipline. ER 1110-345-700 and the other chapters of this document provide items to be addressed in the Design Analysis, Drawings, and Specifications.

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Attachment C	Specifications (See Paragraph 2 in Chapter VIII; a separate set of specifications shall be furnished for Final and Corrected Final designs)
Attachments D thru Z	Miscellaneous (Design computations, etc.)

(*) Note: The above list includes items that must be in the Final Design. The following item descriptions are asterisked to indicate items that must be included in the design analyses submittal for project definition, and project engineering phases for a particular construction feature. If a Part or Chapter is not appropriate, document with "N/A".

PART 1 – GENERAL DESCRIPTION

Describe the purpose and scope of the particular stage of design, and the particular project being designed, generally as follows:

*1. Directive Authorization and Project Description. Give Job Number, Directive Authorization(s) number and date, item category code number, nomenclature, directive scope, programmed dollars, and cost limitation dollars. Provide a brief general description of the project.

*2. A-E Contract Data. Copies of DD Form 1391 (Army projects) and Engineering Instructions with A-E Service Contract Number and date of Notice to Proceed.

*3. Background Criteria. Describe definitive drawings if applicable, and all other drawings or data furnished for design of project. State whether new design or site-adapted.

*4. Government-Furnished Equipment. List any known equipment to be furnished and/or installed by the using service. List any known equipment to be furnished by the Government and installed by the construction contractor.

*5. Security Provisions/Force Protection. State any overall security requirements relating to the project. Address assets to be protected, aggressor threat, and tactics designed against, level of protection.

6. User Information. A compilation of operational characteristics related to design provisions for efficient utilization and maintenance of the overall project to include features built in to provide flexibility, aid housekeeping, control service systems, and provide safety.

*7. Site Visit and Conference Notes. Include copy of notes.

*8. Waivers/Permits. List any waivers that are required, such as fire clearance, building spacing, airfield clearance, POL, ammunition/explosive area, sole source products, etc. State what agency must approve the waiver. Waiver request and documentation therefor should be submitted under separate cover.

*9. Design Quality Control Plan (QCP). An separate QCP shall be attached as Appendix E to each Design Analysis submittal. See A-E contractual provisions and the district Quality Management Plan for the required content.

*10. Economic Summary.

10.1 Summarize results of economic analysis and refer to specific portions of the design analyses which contain the economic analysis.

10.2 Identify results of value engineering studies performed on the project design.

11. Construction.

11.1 Instruction. Designer shall provide directions to field construction managers for special subjects such as new and sensitive technology items and features needing particular attention for quality control, workmanship, assembly, etc.

11.2 Phasing. Summarize any known or anticipated construction phasing/sequencing requirements. Refer to Appendix C for details of phasing.

11.3 Duration. Length of construction period in calendar days, not including weather delays. Coordinate with Appendix C.

*12. Design Problems. Cite any special problems encountered, with recommended solution. Note any significant changes made from criteria and/or previous design stages.

13. Guide Specifications. List all applicable guide specifications.

PART 2 – DESIGN REQUIREMENTS AND PROVISIONS

This part of the design analysis will include subparts for each major design discipline.

CHAPTER 1 - CIVIL

*1. Site Analysis.

*1.1. Existing site description, including facilities, utilities to remain, to be removed, and/or to be relocated.

1.2 Analysis of the most effective use and adaptation of the site for the proposed facility. Briefly explain building orientation, building setbacks, driveway and sidewalk locations and widths, parking area locations and sizes, walking distance consideration, emergency access, mail and garbage access, environmental considerations, and functional relationships to other facilities. Show parking allocation calculations. State whether or not the facility will be accessible to the physically handicapped.

*1.3 Security. Describe the force protection measures designed into the site analysis to mitigate aggressor threats such as standoff zones, and vehicular barriers.

1.4 Briefly explain other siting considerations such as reversal of standard plan and functional and esthetic relationship with surroundings. Explain rationale for locations of borrow areas, disposal sites, and contractor plant areas.

*2. Grading. State the minimum and maximum grades utilized to develop the desired grading and drainage plan. State the rationale used in establishing the finish floor elevation of the building(s) and the overall grading and drainage plan. Any deviation from criteria should be stated and fully explained.

*3. Pavements.

*3.1 Identify the areas to be paved and the type of pavement to be used. Reference Appendix A of Design Analysis, pavement Design.

3.2 The type and volume of traffic, class of roads, and Design Index should be stated, with jurisdiction for any deviation from criteria for those classes. Streets should be classified per TM 5-822-2 (AFM 88-7, Chapter 5).

3.3 All pavement information should reflect the date and recommendations. Reference Appendix A of Design Analysis for additional information.

4. Storm Drainage.

4.1 Proposed storm frequency, rainfall intensity, and methods used for determination of rate of run-off and design of drainage features.

4.2 Provide a description of the existing and proposed drainage patterns, the rationale for the proposed design, and the
impact of future development on drainage.

4.3 Proposed types of materials to be specified for culverts, storm drains, and related structures.

4.4 Describe special drainage structures.

4.5 Provide drainage calculations and drainage area maps as an attachment to the design analysis. See paragraph 10, Calculations.

*5. Utilities.

*5.1 Water Supply and Distribution. General explanation of the existing service. Where major extensions are required, describe system, indicating type, storage, condition, water pressures, and unsatisfactory elements.

5.1.1 Provide statement on type of construction, proposed materials, required flows or capacities, including designer's selected pipe sizes. Where pump stations, storage, or treatment plants are involved, include tentative sizes and basic data (population, fire flows etc.) used in sizing equipment. Provide the domestic and/or fire protection demand(s) and state the static and residual pressure at the building line. State the static and residual pressure in the existing main at the flow rates of the new facility. Cross-reference the mechanical design analysis for the determination

of the water demand. State requirements for valves, meters, and fire hydrants. Attach complete calculations for sizing water piping.

*5.2 Sanitary Sewer. Provide a general description of the existing sewer system located within the area. Describe the revised system as it relates to the operation of the existing system and the proposed new facility.

5.2.1 Describe type of new system, conveyance sizes and grades, pipe materials, and contributing flows. Where lift stations are required, state type of construction, and pump type, flow, head, size, and number. State requirements for manholes and cleanouts. Attach all calculations used in the sizing of system.

5.3 Landscape Irrigation. Provide a general summary of system requirements, including required application rates and types of heads specified. Describe user requirements as to system features and operation used in preparation of the specifications.

*5.4 Gas Supply and Distribution. Provide a general description of the existing gas system located within the area. Describe the new system as it relates to the operation of the existing system and the proposed facility including the pressure and flow-rate capacities of the existing lines to be used and the pressure and flow-rate requirements of the proposed facility.

5.4.1 State the requirements for valves, meters, regulators, blow-offs and drips. Attach all calculations used in the sizing of the new system.

6. Fencing. Provide type and height of fence and describe the area to be secured. State the number, type, and size of gates provided. Describe the fence and gates to be removed and state if the removed fence and gates will be reused in this contract, turned over to the installation, or disposed of.

7. Turf and Landscaping.

7.1. Description of methods of vegetation establishment. Scope of work, such as the number and kinds of trees and shrubs.

7.2 Rationale of the landscape plan and the use of the trees, shrubs and vines in the design of the landscape plan. Facility security must be incorporated into the landscape layout plan and addressed in the design analysis.

7.3 Existing trees to be removed and trees to be saved.

7.4 Instructions for planting, replacement, and maintenance of landscape plants.

*8. Railroads. Statement of type of service for which railroad track will be provided, anticipated volume and type of traffic, and the ruling grade. Proposed type, source, and thickness of ballast, weight of rail, source, treatment and dimensions of ties proposed.

9. Economic Justification. Analyses shall be provided in the choice of basic materials, functional systems, and other design options in sufficient detail to justify economically the materials, systems, and options selected. Suitable documentation shall be provided to:

9.1 Verify that the necessary studies have been made.

9.2 Identify the alternatives considered.

9.3 State the decisions made, and;

9.4 Indicate the basis for the decisions and cost determination. Economic studies should include consideration of maintenance costs for the design life of the structure if such information is readily available. The formalized life cycle costing technique is not required unless the contract has been negotiated to include additional developing of life cycle cost data or alternatives.

10. Calculations. All calculations will be submitted, including calculations for the sizing of utility lines, and storm drainage facilities.

*11. Additional Criteria Needed. List criteria needed to complete final design.

CHAPTER 2 - ENVIRONMENTAL

Refer to AEIM Chapter 12, Environmental Design, for further clarification of submittal requirements. Long-term operations and maintenance considerations and constraints should be identified and documented.

*1. Cultural and Natural Resources. Identify the type of documentation provided to indicate compliance with the National Environmental Policy Act (NEPA). If an Environmental Assessment (EA) or Environmental Impact Statement (EIS) was prepared for the project, discuss portions of the EA or EIS which affected or were included in the plans and specifications. Also identify any historic properties, cultural resources, endangered species, wetlands, or floodplains which affect or were considered in the design. If none of these items were a factor in the design, state such to indicate that their consideration was not omitted.

2. Water Quality and Prevention of Water Pollution.

2.1 Water Supply. Identify and discuss the design criteria used for water supply features such as ground and elevated storage tanks, chlorinating and other treatment units, pumping stations, and water wells. The discussion should include water quality data, assumptions made, catalog cuts for process equipment (minimum 3 each), design parameter sources, applicable regulations, design methodology and calculations, and coordination and compatibility with existing facilities. Constraints imposed on the design by existing water rights (aquifer drawdown restrictions, maximum rates of removal, etc.) should be discussed.

2.2 Municipal Wastewater. Identify and discuss the design criteria used for municipal wastewater systems such as lift stations, pneumatic ejectors, on-site sewerage systems, and wastewater treatment plants. The discussion should include effluent quality data, assumptions made, catalog cuts for process equipment (minimum 3 each), design parameter sources, applicable regulations, design methodology and calculations, and coordination and compatibility with existing facilities and pre-treatment standards. Geotechnical considerations should be documented for projects which include a septic tank and/or drainfield. State Designated Uses of surface water as well as numerical water quality standards of the receiving stream should be researched, evaluated and documented.

2.3 Industrial Wastewater. List industrial and other process wastewater streams that will result from facility operations. Data characterizing the waste stream should be included as well as listing and identifying any pretreatment standards for industrial discharges as covered by 40 CFR 400-471. Identify the receiving Federally Owned Treatment Works (FOTW) or Publicly Owned Treatment Works (POTW) and their pretreatment criteria for industrial wastewater generated by the facility. If the discharge is to a FOTW, the design should be coordinated with the FOTW operators. Discuss the design features and treatment units included in the plans and specifications to meet the POTW criteria, including oil/water separators, retention basins, and acid neutralization facilities. The discussion should include effluent quality data, assumptions made, catalog cuts for process equipment (minimum 3 each), design parameter sources, applicable regulations, design methodology and calculations, and coordination and compatibility with existing facilities.

2.4 Storm Water. If a General Permit for Storm Water Discharges from Construction Sites is required for the project, summarize the temporary storm water controls and the Storm Water Pollution Prevention Plan included in the design for use during project construction. Also discuss permanent features which are included in the design for management of storm water during facility operations. Identify whether or not a storm water permit will be necessary for operation of the completed facility.

3. Air Quality and Prevention of Air Pollution. Identify equipment and facilities in the project that will produce emissions regulated under the Clean Air Act. Discuss design features included to meet applicable regulatory criteria. If demolition of equipment containing Ozone Depleting Substances (ODC) is part of the project, discuss requirements included in the plans and specifications to ensure the equipment is properly purged before demolition. Also identify and discuss emissions that will occur and need to be controlled during construction of the project. Clean Air Act Title V operating permit and permit to construct should be discussed as well as responsibility for permit application process. In air quality non-attainment zones, any special design or construction restrictions should be listed. Future regulations may prohibit operation of heavy equipment during certain times of the day. ACM/NESHAPS coordination and permitting requirements should be documented.

4. Solid Waste (Non-hazardous). Provide an estimate of the quantity (cubic meters) of waste to be generated by operation of the complete facility. Discuss design features (i.e. dumpster pads) included for the collection and temporary storage of the waste. If solid waste compactors, transfer stations, recyclable sorting and storage areas, or disposal areas are part of the project, include a discussion of design assumptions made, catalog cuts for process equipment and off-the-shelf systems (minimum 3 each), design parameter sources, applicable regulations, design methodology and calculations, and coordination and compatibility with existing facilities.

*5. Hazardous, Toxic and Radiological Wastes (HTRW).

All relevant and applicable regulations which affect or impact the design should be cited and/or documented. Specific disposal requirements dictated by each of the projects waste streams should be documented. Requirements for waste manifesting should be explicitly documented (i.e. generator identity, responsibility for filling out the manifests, and authorized personnel to sign the manifests,).

5.1 Asbestos Containing Material (ACM). Identify ACM which will be affected by project construction, and discuss how it is addressed in the plans and specifications.

5.2 Lead-Based Paint (LBP). Identify LBP which will be affected by project construction, and discuss how it is addressed in the plans and specifications. Any target housing should be identified and the applicable abatement standards listed. Application of the AEHA protocol for waste stream characterization should be discussed for demolition projects.

5.3 Polychlorinated Biphenyls (PCB). Identify all electrical equipment, including fluorescent lights, which contain or potentially contain PCBs. PCB Bulk Product Waste (40 CFR 761) should also be identified such as dried paints, mastics, caulks, gaskets, etc. Discuss how the equipment is addressed in the plans and specifications. Historic PCB spills should be identified along with design considerations for the remediation of the spill sites. Regulatory standards and specific requirements regarding cleanup standards, handling, marking, and disposal should be considered in the design and fully documented.

5.4 HTRW other than ACM, LBP, and PCB. If project construction or facility operation after construction will generate HTRW, identify the wastes. Discuss criteria included in the plans and specifications for correct characterization, handling, storage, and disposal of wastes generated during construction. Discuss the design features which ensure that adequate storage facilities will be provided for wastes which will be generated by facility operations. Project specific characteristics and impacts should be documented such as classification as a small or large quantity generator, the need for a temporary 90-day hazardous waste/material accumulation area, and other related requirements such as spill response plans, training etc.

5.5 Contaminated Sites. If the project involves work in an industrial area with a potentially contaminated site, in an Installation Restoration Program (IPR) site, or other known contaminated site, discuss the sampling, monitoring, and/or testing accomplished during design or required in the specifications to determine the presence and extent of contamination in the project area. Discuss how this contamination will be avoided or premeditated during construction. The site's regulatory status, remediation goals, permits or modifications to existing permits, public participation requirements, regulatory consent orders (i.e. CERCLA Record of Decision, Federal Facilities Agreements) should be documented and referenced. Any specific requirements for characterization, storage, transportation, treatment, or disposal of HTRW should be identified.

5.6 Above-ground Storage Tanks (AST) and Underground Storage Tanks (UST). Identify by size, type, and contents storage tanks in the project. Discuss the design features included to meet regulatory criteria for emissions control, tank design, monitoring systems, piping design, and fire safety. Also address notification and registration procedures for tank installation and first fill, if applicable, and discuss how the requirements are being met. If the project involves closure of an existing UST, design considerations for removal vs. abandoning in place should be discussed. Any closure criteria, attendant design features (such as a soil vapor extraction system), or follow on requirements (such as installation of monitoring wells and monitoring program) should be documented.

5.7 Worker Protection. Identify site-specific hazards that may be present while accomplishing the demolition and/or construction work included in the project. Cite where and how worker protection requirements have been addressed by the plans and specifications and discuss the reasoning behind the minimum level of Personal Protective Equipment (PPE) specified. Data needed to make worker protection decisions should be documented. Use of any engineering controls should be discussed. Any special qualifications required by the workers should be documented such as 40-hour Hazardous Waste Operations Training or unexploded ordnance safety specialists.

5.8 Universal Wastes. Identify universal wastes such as mercury thermostats and switches, fluorescent lights, disposable batteries etc. and document disposal requirements and/or special handling.

5.9 Unexploded Ordnance (UXO). Projects should be evaluated for UXO implications and findings documented.

*6. Federal, State, and Local Permits. Identify the environmental permits and notifications necessary to construct the facility and discuss how they are addressed in the plans and specifications. Also identify permits which the customer will need to operate the facility. For all permits, clearly outline who the regulatory authority is, what type (water, air, waste, other) of permit is needed, what phase or part of the project requires the permit (i.e. asbestos removal, construction or tank operation), and who is responsible for obtaining the permit. The entity responsible for regulatory coordination should be specified.

7. Sustainable Design. Use of green building technologies utilized during the design or construction to minimize waste generation, encourage recycling, reduce energy consumption, and/or preserve natural resources should be evaluated and documented. Refer to ETL 1110-3-491 for basic criteria and information pertaining to incorporating sustainable design.

CHAPTER 3 - ARCHITECTURAL

*1. General Description. Briefly describe the proposed facilities, functional purpose, capacities and type of construction. Confirm any building fire protection and physical security classifications cited by the project criteria. Refer to Architectural chapter III and chapter XI for further clarification of design documentation requirements for different phases/types of project submittals.

*2. Criteria References. List architectural criteria references numerically.

*3. Design Criteria. Present design data and/or show numerical
reference and page number as applicable for the following:

3.1 Space Allocations. State program scope, personnel capacity, and any unit or statutory limitations for building. State comparable gross scope and unit factors for proposed design. List programmed and proposed net area for each space and occupant capacity thereof.

3.1.1 External Activities. Summarize external operations, activities, parking and circulation including vehicular and pedestrian traffic flow on any adjoining site.

3.1.2 Internal Activities. Confirm activities, matrix or adjacency relationship cited in project criteria. Clarify equipment, furniture or furnishing requirements. Establish interior heights and operational clearances for special equipment.

*4. Basic analysis. Confirm scope and establish basis for proposed design in relation to the DESIGN CRITERIA cited above.

4.1 Master Plan/Future Expansion. Reference master plan and future expansion requirements. Explain coordination and interface with master plan and flexibility of plan for future expansion.

4.2 Visual Features. Describe visual setting, setbacks, primary views or focal points and physical features of the site. Name existing permanent facilities, function and location that influence design and materials selections.

Explain any historical, traditional and community interrelationships which influence design. Describe visual appearance to and from dominant facilities.

4.3 Spatial Composition. Provide spatial analysis of optimum land use, massing, proportioning and balance between facilities, paving and open space. Describe basis for grouping buildings, exterior circulation, form and configuration in terms of functional clearances, sound, fire or protective construction zones.

4.4 Accessibility. Analyze required aggressor security threat(s) defensive measures, primary, secondary, service, fire and walkway access, building to building and parking relationships.

4.5 Energy Conservation. Establish solar design load, altitude, azimuth and shade factors. Describe prevailing summer and winter wind and micro-climate and passive solar criteria and bases for orientation and building fenestration. If active solar equipment is utilized, describe location, arrangement and service access.

4.6 Functional Organization. Describe significant bases for plan arrangement, space adequacy relationships circulation and equipment placement and physical security measures. Clarify life of functions accommodated and flexibility of design for operational changes.

4.7 Life Safety.

4.7.1 Fire Safety. Explain external and internal fire hazards effecting design. Analyze building type and fire protection classifications including multiple occupancies. Confirm occupancies by room and project criteria and coordinate equivalent occupancies with the mechanical analysis. Describe fire separations, exit conditions and units, fire fighting access and class of finishes. (These data may be parts of the fire safety chapter and referenced.)

4.7.2 Barrier Free Design. Cite physically handicapped and OSHA criteria relevant to project design. Explain access and design response for the physically handicapped and any provision for OSHA or blind vending as applicable.

4.7.3 Security. Discuss physical security in form of assets to be protected, aggressor threat, level of protection, occupant safety, lock keying, radiation protection and restricted access areas. Discuss facility lay-out and building elements designed into the facility to address security.

4.8 Acoustical Design. Cite external and internal noise sources, decibel or noise zone ratings and sound attenuation criteria. Describe resolution of external and internal sound levels, sound attenuation separations and detail measures.

*5. Building Systems, Materials & Equipment. Describe basis for building systems, exterior and interior materials and equipment selections as applicable in accordance with the C.S.I. index below. For detail instructions on each subject refer to Architectural chapter guidance.

1. General
2. Sitework
3. Concrete
4. Masonry
5. Metals
6. Wood
7. Roofing/Insulation
8. Doors and Windows (Hardware)
9. Finishes (Interior & Exterior)
10. Specialties (Signage)
11. Equipment (Contractor/ Government Furnished
12. Furnishings
13. Special Construction
14. Conveying Systems
15. Mechanical
16. Electrical

*6. Economic Justification.

6.1 Discuss adequacy of programmed amount for comprehensive design and major architectural systems in terms of efficient operational and building construction performance, maintenance and cost. Provide life cycle or comparative cost analysis for the following systems when over $100,000 construction value.

6.1.1 Roofing

6.1.2 Exterior wall

6.1.3 Interior Partitioning

6.2 Describe significant architectural aspects of constructibility in the cost estimate including availability of materials, labor, skills, local construction practices,

weather and site conditions and items requiring long lead times or special procurement.

*7. Criteria/Approvals Requested. Summarize additional project criteria, waivers or approval actions required for proceeding with design. List recommendations for resolution of conflicts in criteria and requests for deviation.

8. Calculations. The final architectural design analysis shall be supported by the following:

8.1 Space Allocations: Show computations for space layout including net room areas and gross building areas (indicate mechanical and electrical space separately). Categorize areas and capacities under operations, administrative, storage and support requirements.

8.2 Energy Conservation.

8.2.1 U-values. Show calculations for floor, walls and roof assemblies.

8.2.2 Passive Solar Design. Provide graphics and calculations for solar control including solar load, orientation, day lighting, shade factors and ratio of glazing to room area.

8.3 Life Safety.

8.3.1 Fire Protection. Show or reference data and calculations for criteria area limitations, separations, exit units and distance to exits.

8.3.2 Design for the Physically Handicapped. Include documentation and checklist analysis of design requirements for the physically handicapped or blind vending where applicable.

8.4 Acoustical Design. Show calculations for external and internal sound attenuation.

8.5 Economic Justification. Include economic data and life cycle calculations as appropriate.

CHAPTER 3 A - INTERIOR DESIGN

Note: The basic interior design analysis for Building Related/Structural Interior Design is an integral part of the Architectural Design Analysis. The extended interior design analysis for Furniture Related/Comprehensive Interior Design is outlined below:

1. General Description:

Briefly reference the project design and summarize the extended design services provided.

2. Criteria References:

List interior design criteria references numerically.

3. Design Criteria:

Present design data and/or show numerical reference and page number as applicable for the following:

3.1 Space Allocations. Confirm adequacy of net space provided under the project design in relation to the furniture and furnishing needs.

3.2 Internal Activities. Confirm the adequacy of programmed furniture furnishings and equipment in relation to internal activities and interior design needs.

4. Basic Analysis:

4.1 Functional Evaluation. Discuss the functional criteria and objectives of the design and how the design arrangement and selection of basic components satisfy the needs of functional groupings. Describe functional design in terms of accessibility, circulation, mobility, safety, and interchange ability of components.

4.2 Environmental Response. Discuss the design basis for selection of color, finishes, furniture, and furnishings in relation to climate, daylighting, physical and cultural design conditions. Describe the environmental design response in terms of dominant spaces, focal points, visual features, relationship to exterior design, solar and acoustical control.

4.3 Economic Justification. Discuss the selection and procurement of interior design items from the standpoints of durability, maintenance and value for projected term of use. Outline bases for any procurement and timing divisions.

CHAPTER 4 - STRUCTURAL

When site-adapting standard working drawings or designs used at other locations, the data required herein should be limited only to design changes and/or updating for conformance to current criteria. Refer to structural chapter IV and chapter XI for further clarification of design documentation requirements for different phases/types of project submittals.

*1. Reference. List applicable technical criteria source publications.

*2. Description of structural system. Specific descriptions should be as follows:

2.1 Framing System. A general description and reasoning for selection of the superstructure framing system of the building should be given. Reasoning for selection of the framing system should include requirements for seismic design and/or for security threats, when applicable. Typically economic considerations should be the main factor in selecting one type of framing system instead of another. System examples: (1) the framing system consists of load-bearing reinforced masonry shear walls at the building perimeter with interior steel columns supporting continuous structural steel girders that support joists. A metal deck roof diaphragm and rigid floor diaphragm are used; (2) the framing system consists of ordinary moment resisting steel frames supporting bar joists that support floor slab and a metal deck roof diaphragms; (3) the framing consists of braced steel frames of tube columns and steel beams. Interior framing consists of tube columns supporting joist girders that support bar joists. A metal roof deck serves as a diaphragm to transfer loads to the braced frames. Ties encased in concrete below the slab-on-grade will connect the piers at each braced frame; (4) the framing system consists of reinforced concrete moment resisting frames and pan joist floors and roofs that are diaphragms.

2.2 Foundation System. Foundation design data and description of type of foundation system used. Reference Foundation Design Analysis, (Appendix B).

2.3 Roof and Floor System method of framing and type of deck. Define if/how the floors and roofs participate in the design of the building lateral load carrying system. When appropriate, state that the roof deck type and thickness forms part of a protective security system for protection against an aggressor or radiation resistance.

2.4 Walls and Partitions. Composition, thickness, of exterior walls and location of all load-bearing and shear walls. When the exterior wall type and thickness was selected to form part of a protective security system or for radiation resistance, so state. Non load-bearing partitions are normally considered to be an architectural item.

*3. Design Loads. Cover roof and floor live loads, crane loads, design wind, seismic design parameters, and unusual dead/live loads due to the facility functional requirements, and include blast loading for security design of roof, walls and frames when applicable. State allowances for future loads.

4. Design Basis. Concrete, masonry, reinforcing, structural steel, light-weight steel framing, bar joists, steel decks, bolts, welds, etc. design materials strengths and material specifications should be referenced. Building code(s) used with load and strength resistance factors, load factors, load combinations or code allowable stresses defined where used in the analysis.

5. Lateral Load Analysis. In addition to analysis for vertical gravity loads, a complete lateral load analysis is required for all buildings to show adequacy of a continuous load path from the point that the lateral load is applied to the foundation. Design lateral loads caused by wind and due to earthquake ground motion shall be analyzed. In regions of low seismically, the seismic analysis should be sufficient to show that wind forces rather than seismically induced forces controls design of the lateral load resisting members. Chapter IV paragraphs 23 and 23.1 contains information to assist in this determination. Even when wind loading controls, typically the resisting system must incorporate some prescribed special requirements for seismic loads contained in seismic design criteria. When seismic controls the basic seismic-force resisting system shall conform to one of the acceptable types indicated in Table 7-1 of TI 809-4 subject to the limitations

on height based on Seismic Design Category indicated in the table. The design analysis shall fully describe the method of resisting lateral loads and design all components and connections in this system from the roof to the foundation. Examples of system descriptions are contained in the Framing System descriptions in paragraph 2.1 above.

6. Security Analysis. Identify the assets to be protected, threat to those assets, the level of protection required. State when conventional construction has been determined to be appropriate for the security threat and level of protection required. When the type of threat and level of protection requires, describe and include analysis for the protection measures designed into the structural system. When appropriate address blast resistant concrete roof thickness and reinforcement, wall type and its thickness and reinforcement, moment resisting frames, shear walls, measures to prevent progressive collapse etc. References TM 5-853-2 should be used as guidance for Concept level design and TM 5-853-3 for final design.

7. Economic Justification. Alternative analyses shall be provided on the choice of basic materials, structural systems, spacing, and other design options in sufficient detail to justify economically the selected configuration. Suitable documentation should be provided to:

7.1 Verify that the necessary studies have been made.

7.2 Identify the alternatives considered. Typically, three competitive systems should be considered.

7.3 Indicate the basis for the decisions and cost determination, including the impact, if any, on mechanical, electrical and architectural.

7.4 Economic studies should include consideration of maintenance costs for the design life of the structure if such information is readily available. The formalized life cycle costing technique is not required unless the contract has been negotiated to include additional developing of life cycle cost data or alternatives.

*8. Calculations. All calculations will be submitted in the design analysis; including:

8.1 Member sizing to satisfy design code provisions for carrying member shears, moments and member design stresses from a structural analysis for specified design load combinations, including secondary stress calculations wherever applicable, with explanation for assumptions and conclusions. Connection design for joining structural members together and to the building foundation.

8.2 Serviceability and Deflection. Verification that members selected will be adequate for deflection caused by load, to limit vibrations, for expansion, sound control, durability and maintainability and comfort of occupants. Structural foundation, frame and walls are compatible with potential settlement/expansion movements induced by earth foundation.

8.3 Sizing of foundations to carry structural loads into the earth, structural members and connections.

8.4 Uplift and stability. Light structures or components thereof shall be checked/designed for uplift due to wind, and buildings with basements or pits below grade shall be checked/designed for uplift due to water in the foundation materials.

CHAPTER 5 - MECHANICAL

*1. Heating, Ventilating, Air Conditioning, Refrigeration, Energy, Piping and Plumbing Systems.

1.1 Requirements, criteria sources, and references for all design considerations for the following general parameters shall
be included:

1.1.1 Criteria listing. Manuals, pamphlets, codes, technical references, etc.

1.1.2 Temperature extremes and other impacts of climate such as wind, precipitation, sun angles, and humidity. Coordinate with architectural design.

1.1.3 Apparent competitive mechanical systems in view of fuel alternatives, energy budgets and environmental impacts, including description and justification for any connections/ expansions of existing systems.

1.1.4 Indoor environmental conditions including temperatures, humidity, pressurization, ventilation, and exhaust requirements.

1.1.5 General HVAC zones and personnel loads.

1.1.6 General toilet and sanitation zones, and occupant capacities (Men and women by functional area).

1.1.7 Water supply pressure.

1.1.8 Existing or planned sanitary sewer capacities.

1.1.9 Toxic or hazardous pollutant sources.

1.1.10 Functions and occupancies requiring mechanical lifts, elevators and cranes.

1.1.11 Special waste and drainage systems.

1.1.12 Energy sources and capacities including heating and chilled water distribution, gas distribution, and fuel storage.

1.1.13 Building and related mechanical system commissioning.

1.2 Include FUNCTIONAL AND TECHNICAL REQUIREMENTS for the following items:

1.2.1 Outside design temperatures and U-values for building construction elements (roofs, walls, floors, etc.).

1.2.2 Equipment heat release data.

1.2.3 Heating and/or air conditioning, refrigeration, including humidity control. (Inside design conditions, outside air requirements, times of occupancy, filtration requirements, zoning, diversity, etc.)

1.2.4 Mechanical ventilation (air circulation) and special exhausts. (Areas requiring ventilation, rates used, filtration requirements, etc.)

1.2.5 Control and disposal of toxic or airborne-polluting substances within the facility and pollutants from the energy systems. (Identify substances, allowable levels, etc).

1.2.6 Energy conservation including solar and recovery systems. (Life cycle costing, energy budgets, ECIP, solar analysis requirements)

1.2.7 Total energy/selective energy systems. (Study directive)

1.2.8 Standby heating and cooling, and emergency environmental systems. (Identify areas, criteria guidance, systems)

1.2.9 Existing and new energy distribution systems serving/on the site. (Existing capacities, type system – natural gas/heating cooling distribution, type of control, piping criteria, etc)

1.2.10 Toilet fixture allocation (Fixtures/person for men and women by functional area).

1.2.11 Domestic hot and cold water systems, supply temperatures and recovery systems (include adequacy for fire protection).

1.2.12 Compressed air and vacuum production components.

1.2.13 Sanitary waste and vent piping.

1.2.14 Acid waste and chemical piping, and neutralization.

1.2.15 Coordination with the connection to site utilities.

1.2.16 Mechanical lifts, hoists and elevators.

1.2.17 Control of airborne-polluting substances within the project.

1.2.18 Control of polluting substances from energy systems.

1.2.19 Treatment and disposal of toxic and/or polluting substances within the project.

1.2.20 Safety and occupational health requirements.

1.2.21 Special Force Protection requirements, protective requirements and security measures, (i.e., Terrorism protection measures, EMR/RFI protection, secure areas, vibration, noise, etc.)

1.2.22 Seismic design and expansive soil requirements. (Identify seismic requirement, pertinent soils, data, etc. Coordinate with structural and foundation design. Identify seismic pipe and equipment bracing requirements.)

1.2.23 Handicapped accessibility/features.

1.2.24 Special process and specialty equipment requirements.

1.3 Provide brief discussion of DESIGN OBJECTIVES AND PROVISIONS for the following (define methods used to meet functional and technical requirements):

1.3.1 Impacts and benefits from natural warming and cooling effects afforded by the site (see architectural chapter) and coordination with passive solar design.

1.3.2 Heating and/or cooling system life cycle cost design to include basis for system selection. (Provide summary analysis of each competitive system, including costs and energy usage. Include descriptions of system(s) selected.)

1.3.3 Air distribution. (Include sizing method used and zoning because of occupancy, function, orientation and fire safety. Detailed fire safety zoning requirements should be included under Part X, Fire Safety.)

1.3.4 HVAC Piping systems. (Define piping systems used within building including type of pipe, insulation requirements, whether piping is concealed or exposed).

1.3.5 HVAC system expandability and feasibility. (Identify provisions for expanding system).

1.3.6 Energy conservation. (Define energy conservation features. Identify ECIP and energy budget results).

1.3.7 Vibration/noise isolation. (Provisions for mechanical equipment and ductwork).

1.3.8 Energy distribution systems. (Central plant distribution system-distribution medium, temperatures, pressures, type system, piping/insulation materials, etc.)

1.3.9 Control of polluting and toxic substances.

1.3.10 Temperature control systems. (Identify any special requirements; include control sequences and EMCS requirements. Briefly define fire safety provisions. Refer also to requirements under Part X Fire Safety and Part VI Electrical – for EMCS).

1.3.11 Consolidation of toilet and sanitation facilities.

1.3.12 Domestic water supply and waste piping systems. Include type of pipe, insulation requirements, whether concealed or exposed.

1.3.13 Domestic water heating systems (include storage and recovery capabilities, operating temperatures, pump requirements, and whether oil, gas, or electric).

1.3.14 Interior natural gas systems.

1.3.15 Connection to utilities.

1.3.16 Plumbing system expandability and feasibility. (Identify provisions for expanding system).

1.3.17 Mechanical lift, hoist, crane and elevator designs.

1.3.18 Force protection and other security features included in the mechanical systems design (system anchoring, clear zones, protection of openings, etc.)

1.3.19 Seismic design and expansive soils. (Identify provisions included in design such as seismic bracing and pipe sleeves through slab-on-grade and grade beams for expansive soils.)

1.3.20 Description of features/systems for enhancement of maintenance and operation. (Additional data is noted under Part XI).

1.3.21 Economy of construction/procurement, operation and maintenance: life-cycle cost effectiveness.

1.3.22 Provisions for building and related mechanical system commissioning, and the testing adjusting and balancing of mechanical systems.

1.3.23 Special safety and occupational health requirements relating to mechanical systems.

1.3.24 Special process and specialty equipment requirements.

1.4 Provide calculations for the following: (Refer to CHAPTER V, MECHANICAL, FOR EXTENT OF CALCULATIONS REQUIRED AT EACH STAGE OF DESIGN; SWD or ASHRAE standard forms shall be used for manual calculations):

1.4.1 Design load calculations and life cycle cost analysis shall be computed in accordance with recognized procedures and as designated by criteria. Step-by-step calculations, summaries, and narrative shall be provided to explain the procedures and results or conclusions. Computerized calculations shall indicate the basis of all input data and other information previously designated in subparagraph: AUTOMATED DATA PROCESSING (ADP) of this chapter. Sample manual calculations to verify the computer design peak loads and typical room calculation(s) shall be submitted for review. Calculations shall include the following and/or separate study documents referenced, as applicable:

1.4.1.1 Heating, air conditioning, ventilating, and refrigerating design loads u-value derivations.

1.4.1.2 Air distribution design.

1.4.1.3 Piping design.

1.4.1.4 Estimated annual unit energy consumption.

1.4.1.5 Alternative energy system analysis (fuels and systems), energy budget analysis, and solar analysis shall be provided as designated by criteria.

1.4.1.6 Energy recovery systems.

1.4.1.7 Total energy/selective energy studies (as directed).

1.4.1.8 Fixture allocations (ensure the quantity of fixtures is coordinated with architectural design).

1.4.1.9 Maximum flow rate (LPM) for domestic hot and cold water, and total flow per day.

1.4.1.10 Sizing of domestic hot and cold water supply systems, including storage tanks.

1.4.1.11 Sizing of interior gas distribution systems.

1.4.1.12 Maximum flow rate (LPM) for waste water and sewage, and total flow per day.

1.4.1.13 Sizing of waste water and sewage drain system.

1.4.1.14 Sizing of special gas and liquid distribution systems.

1.4.1.15 Complete system and unit capacities, indicating dimensions of all equipment. (3 manufacturers identifying specific model numbers, styles, etc., to fully define the selection shall be cited for each major item of equipment).

1.4.1.16 Cost comparison of competitive systems.

1.4.1.17 System noise isolation, seismic requirements, force protection, and necessary references to fire protection.

1.4.1.18 Special requirements for safety and occupational health.

1.4.1.19 Environmental impact analysis including energy system pollution abatement and control of toxic and airborne polluting substances.

*2. Other Systems. Brief description of other mechanical systems not defined herein, identifying functional and technical requirements, design objectives and provisions. Calculations supporting the design shall be provided.

*3. Economic Justification. Analyses shall be provided on the choice of basic materials, functional systems, and other design options in sufficient detail to justify economically the materials, equipment, systems, and options selected in accordance with applicable criteria. An energy analysis for all systems considered shall be provided. (Refer to ETL's, AEI, MIL-HDBK-1190,and SWD Criteria Letters.)

3.1 Suitable documentation shall be provided to:

3.1.1 Verify that the necessary studies have been made.

3.1.2 Identify the alternatives considered and summarize results.

3.1.3 State the decisions made, and

3.1.4 Indicate the basis for the decisions and cost determination.

3.2 Economic studies shall include consideration of initial maintenance and operation costs for the design life of the structure. Additional definition of these requirements is provided in Part II, ENERGY CONSERVATION.

4. Fire Safety Provisions. Provide brief description identifying functional and technical requirements, design objectives and provisions.

4.1 Fire Extinguishing Systems. Brief descriptions of systems provided including hazard classification, densities, areas of demand, flow and pressure requirements. Include calculations to support design. See Chapter V for extent of calculations required at various design stages.

4.2 HVAC FIRE/SMOKE CONTAINMENT/REMOVAL SYSTEM. Provide brief description identifying the type of systems used and method of operation. (Refer to Part X. FIRE SAFETY)

*5. Coordination with installation or outside agencies:

5.1 List additional/criteria needed for final design.

5.2 Identify requirements for total energy/selective energy planning.

5.3 Identify maintenance support requirements.

5.4 Indoor environmental requirements including temperatures, humidity, and outside and exhaust air requirements.

5.5 Type, number schedule and activity level of occupants.

5.6 Equipment to be installed along with utility requirements, environmental requirements and heat release.

5.7 Requirements for mechanical lifts, hoists, cranes and elevators.

CHAPTER 6 - ELECTRICAL.

*1. Provide requirements, criteria sources, and references for the following general parameters as applicable.

1.1 Type of occupancies.

1.2 Specialized functions/equipment.

1.3 Communications support.

*2. Interior Electrical Distribution System.

2.1 Include FUNCTIONAL AND TECHNICAL REQUIREMENTS for each of the following items, as applicable:

2.1.1 Illumination levels (include general and task lighting). State design basis such as TI 811-16, MIL-HDBK-1190, I.E.S., Definitive Drawings, etc.

2.1.2 Installation and equipment standards.

2.1.3 System voltage, low and high.

2.1.4 Emergency lighting and stand-by generation.

2.1.5 Communications to include call systems.

2.1.6 Electronic clock systems.

2.1.7 Electronic security, surveillance and intrusion detection systems.

2.1.8 Audio visual systems to include central TV systems.

2.1.9 Fire/smoke alarm systems.

2.1.10 Lightning protection system.

2.1.11 Static grounding system.

2.1.12 Energy conservation and energy monitoring.

2.1.13 Cable TV.

2.2 Provide brief description of DESIGN OBJECTIVES AND PROVISIONS for the following:

2.2.1 Electrical characteristics (phase, voltage, and number of wires) of circuits to serve load in KVA for the facility. Justification for the type of system proposed (economics or special conditions).

2.2.2 General illumination and task lighting coordinated with interior layouts, safety and security requirements.

2.2.2.1 Tabulation showing room name and number with lighting intensity and type of fixture, either by Standard Drawing Number or Catalog Number, for each room.

2.2.2.2 Provisions for adjustment and/or relamping of light fixtures that may not be readily accessible.

2.2.2.3 Description of exit and emergency lighting system; if none to be provided, so state.

2.2.3 Power requirements, with description of panel, protection devices to be provided, and typical loading of circuits.

2.2.4 Location of special power outlets (voltage, phase, and amperage).

2.2.5 Type of wiring system, such as rigid conduit, electrical metallic tubing, non-metallic sheathed cable, etc., and where proposed to use.

2.2.6 Proposed additions and alternations or special items of design, such as specialized equipment, security requirements, emergency power, etc.

2.2.7 Special communication or electronic requirements.

2.2.8 Type of signal and fire alarm systems.

2.2.9 Telephone requirements will be as provided by the communication officer at each installation. Coordination shall be through HQ USACE for Army projects and AFRCE-CR for Air Force projects.

2.2.10 Define any hazardous areas.

2.2.11 Lightning protection system; if none, so state.

2.2.12 Static grounding system to be installed, if required.

2.2.13 Voltage drop basis for service entrance, panel feeders, and branch circuits.

2.2.14 Emergency power distribution.

2.2.15 Energy Conservation.

2.2.16 Description of systems for enhancement of maintenance and operations, to include systems flexibility.

2.2.17 Cable TV.

2.2.18 Economy of construction/procurement, operation and maintenance: life cycle cost effectiveness.

2.2.19 Energy monitoring and control systems (Requirements shall be coordinated with those lists in Part 2, Chapter 5 - Mechanical.

2.3 Calculations REFER TO CHAPTER VI, "ELECTRICAL", FOR ADDITIONAL CALCULATIONS REQUIRED FOR SPECIFIC ELEMENTS OF DESIGN. (Fully coordinate calculations with those required for exterior electrical.)

2.3.1 Maintained lux (lx) levels in all areas. (Where areas are similar in size and usage, only a typical calculation is required).

2.3.2 Individual circuit and system loads tabulated in amperes for each panel board or switch board.

2.3.3 Transformer, generator, switchboard, and feeder computations indicating all demand, diversity, ambient-temperature or conductor-grouping factors considered in the selection of equipment or conductor sizes.

2.3.4 Calculations will include a fault current and ground fault protection study supporting the interrupting rating chosen for all equipment.

2.3.5 Life cycle cost comparison of alternative illuminating, power and communication systems.

2.3.6 Selective system protection.

2.3.7 Voltage-drop on all service and feeder circuits, and on worst-case branch circuits supplied by each panel board and switch board.

2.3.8 Weight and dimensions of each major item of equipment (supported by manufacturer's names and catalog/model numbers).

2.3.9 Voltage dip calculations for motor starting.

*3. Exterior Electrical Distribution System:

3.1 Include functional and technical requirements for each of the following items as applicable:

3.1.1 Primary source.

3.1.2 Loads and load factors including allowance for future loads.

3.1.3 Installation and equipment standards.

3.1.4 System voltage, low and high.

3.1.5 Stand-by generation.

3.1.6 Low and high voltage switching.

3.1.7 Communications systems.

3.1.8 Electronic security, surveillance and intrusion detection support systems.

3.1.9 Cable TV system.

3.1.10 Energy conservation and energy monitoring.

3.1.11 Power and lighting for site elements.

3.1.12 Cathodic protection.

3.2 Provide brief description of DESIGN OBJECTIVES AND PROVISIONS for the following:

3.2.1 Adequacy of the primary supply at the point of take-off. If primary source is inadequate, state measure(s) proposed to correct the deficiency. Description of power supply (voltage, phase, number and size of conductors) at point of delivery.

3.2.2 Electrical characteristics of the primary extension (voltage, phase, number and size of conductors). Indicate adequacy and corrective action, if necessary, of the existing distribution system at the point of take-off. Indicate characteristics and standards of design for overhead or underground line. Include justification for underground line.

3.2.3 Estimate of total connected load and resulting demand load by applying demand and diversity factors for loads involved. Include any allowances for future loads. Indicate type, number of units, KVA capacity, primary and secondary voltage of the transformer installation proposed. Also indicate types of primary and secondary connection of transformers.

3.2.4 Basis for selection of primary and/or secondary distribution voltage.

3.2.5 Low and high voltage switching.

3.2.6 Type of conductors, such as copper or aluminum, and where they are proposed. Refer to guide specifications for options.

3.2.7 Pertinent standards of design, such as voltage drop, physical characteristics of overhead or underground circuits, type of lighting units, lighting intensities, and type of transformers.

3.2.8 Street lighting, security lighting, parking lot lighting, sidewalk lighting, rail-yard lighting, etc. requirements.

3.2.9 Installation of cathodic protection system, including design values.

3.2.10 Definition of any hazardous areas.

3.2.11 Transmission systems for communications, security, fire, and Utility Monitoring and Control Systems (UMCS).

3.2.12 Emergency power distribution.

3.2.13 Energy conservation.

3.2.14 Description of systems for enhancement of maintenance and operations, to include systems flexibility.

3.2.15 Economy of construction/procurement, operation and maintenance: Life cycle cost effectiveness.

3.3 Calculations REFER TO CHAPTER VI, "ELECTRICAL", FOR ADDITIONAL CALCULATIONS REQUIRED FOR SPECIFIC ELEMENTS OF DESIGN. (Fully coordinate calculations with those required for interior electrical.)

3.3.1 Transformer, generator, switchboard, and feeder computations indicating all demand, diversion, ambient-temperature or conductor-grouping factors considered in the selection of equipment or conductor sizes.

3.3.2 Calculations will include a fault current and ground fault protection study supporting the interrupting rating chosen for all equipment.

3.3.3 Life cycle cost comparison of alternative illuminating, power and communication systems.

3.3.4 Primary selective system protection including recloser and circuit breaker settings.

3.3.5 Voltage-drop on all service and exterior feeder circuits.

3.3.6 Maintained lux (lx) levels in all exterior areas.

3.3.7 Cathodic protection system.

3.3.8 Strength and sag calculations for power lines and poles including conductor sag and clearance, down guy strengths, etc.

3.3.9 Weight and dimensions of each major item of equipment. (Supported by manufacturer's names and catalog/model numbers.)

*4. Economic Justification. Analyses shall be provided on the choice of basic materials, functional systems, and other

design options adequate and in sufficient detail to justify economically the materials, systems, and options selected. An energy impact analysis for all systems or equipment considered will be included. Rationale for selection of reduced-voltage starting equipment shall be specifically stated. Analysis shall reflect a summary of detail system and unit capacity calculations. Suitable documentation shall be provided to:

4.1 Verify that the necessary studies have been made.

4.2 Identify the alternatives considered and summarize results.

4.3 State the decisions made, and

4.4 Indicate the basis for the decisions and determination. Economic studies shall include consideration of maintenance costs for the design life of the structure.

*5. Coordination with installations and availability.

5.1 Telephone system requirements and availability.

5.2 Central TV.

5.3 Power requirements of the installation's service and cleaning equipment.

5.4 Provost marshal or police response to intrusion detection system alarms.

5.5 AR 190-13 intrusion detection system design approvals, when required.

5.6 List any additional criteria needed to complete final design.

CHAPTER 7 - FIRE PEOTECTION AND LIFE SAFETY

*1. This part of the Design Analysis shall be a thorough and complete treatment of fire and life safety. Except for calculations performed under other parts of this Design Analysis, this part shall be sufficient in detail and presentation to be considered as a "Stand-alone" Fire Safety Design Analysis.

*2. Requirements, criteria sources, and references for all design consideration for the following General Parameters shall be included.

2.1 Criteria listing. Manuals, pamphlets, codes, technical books, etc.

2.2 Programmed building classification, types of occupancies and list of hazardous areas/equipment/building contents.

2.3 Type of construction.

2.4 Area separation of structures and exposure protection.

2.5 Type of fire protection.

2.5 Fire fighting support including access and clearances to site and structure.

2.6 Presence of handicapped occupants.

2.7 Relative importance and essentialness of equipment supplies and facilities.

2.8 Priority of fire protection including definition of the following items: size and value of structure or facility, value of the contents, processes or equipment as related to the fire protection available from local fire fighting resources, facility design, and usage.

2.9 Fire protection during construction.

2.10 Adequacy of water supply.

*3. Include FUNCTIONAL AND TECHNICAL REQUIREMENTS for the following items. If the item is not applicable so state.

3.1 Building classification based on U.B.C., occupancy classifications, area limitations. Construction for fire and smoke resistance of the building including roofs, ceiling assemblies, interior and exterior walls, permanent partitions, shafts, location of fire separation walls and partitions, and doors.

3.2 Allowable floor area and building height in accordance with the Uniform Building Code (UBC) based on occupancy classification, construction, separations and fire suppression or protection.

3.3 Exit requirements in accordance with NFPA 101, Life Safety Code (LSC). The design and analysis must address exit types, required exit widths, maximum travel distance for exiting, dead-end distances and common exit paths of travel limitations, arrangement of exits, remoteness of exits, discharge from exits, illumination of exits and exit marking.

3.4 Flame spread and smoke development ratings of interior finishes (to include furnishings)and insulation.

3.5 Building access for local fire department fire fighters.

3.6 Building separation and exposure protection.

3.7 Smoke control methods.

3.8 Fire alarm evacuation systems.

3.9 Fire detection systems.

3.10 Automatic fire extinguishing systems (including occupancy classification for the sprinkler system).

3.11 Standpipes and/or fire hydrants.

3.12 Water supplies to include new or additional storage, pumping, and/or water distribution mains.

3.13 Special hazards and methods of protection.

3.14 Manual fire extinguishing (FE) systems (including F.E. cabinets).

3.15 Seismic design and expansive soils (identify seismic requirements and/or existence of expansive soils).

3.16 Include requirements for force protection (protection of penetrations, access, etc.)

4. Provide brief discussion of DESIGN OBJECTIVES AND PROVISIONS of the following (if the item is not applicable so state):

4.1 Treatment of each potential hazard (including building construction, occupancy, zoning, extinguishment, area separation, detection, alarm, etc.).

4.2 Provision and maintenance of an unobstructed emergency egress system to include consideration for the handicapped.

4.3 Detection, alarm, annunciation for fire and smoke (full coordination between Part V and Part VI of design analysis).

4.4 Fire and smoke control for HVAC systems. (Full coordination for fire and smoke damper locations, zoning, detection, and alarm. Include control sequences for air side HVAC equipment.)

4.5 Water Supplies, including water flow tests at the point of connection for sprinkled buildings (storage, pumping, flows, pressures, etc.).

4.6 Existing fire hydrants.

4.7 Existing fire alarm reporting system information for the new connections.

4.8 Economy of construction and procurement, and life cycle cost effectiveness

4.6 Force protection and anti-vandalism (features included to ensure system integrity and operation).

4.7 Efficiency of fire safety and fire protection features and egress system as incorporated into the building layout including economic tradeoffs involved (support by drawings as appropriate).

5. Design Calculations. Calculations shall be included for the following items. (Where calculations have been accomplished under other parts of this design analysis, the part and page number shall be referenced and a summary of results and conclusions provided under this part.)

5.1 Complete exit requirement calculations based on LSC.

5.2 Allowable floor area and building height calculations based on UBC.

5.3 Water supply calculations indicating the adequacy of the design to meet sprinkler and hose stream demands. Calculations must be based on residual static pressures and flow data obtained from water flow tests.

5.4 Sprinkler calculations to determine water flow and pressure demands.

5.5 Fire alarm system calculations for elements such as, wire sizing, battery, and alarm annunciator sound level.

5.6 Complete hydraulic design calculations for detailed sprinkler and Aqueous Film Forming Foam (AFFF).

5.7 Layout and sizing of special fire extinguishing systems, such as carbon-dioxide, halon, and AFFF (low pressure foam system).

*6. Coordination with installation or outside agencies.

6.1 List additional criteria and information needed to complete final design.

6.2 Fire fighting support to include tie-ins with local fire department alarm and annunciation systems.

6.3 Adequacy of water supply, including flow tests.

6.4 Inspection and testing of systems performance.

6.5 Obtain the specific fire alarm type(s), fire protection and central reporting requirements of the Installation’s Fire Marshall/Chief.

7. Fire Protection Drawings. The following information is provided to organize the fire protection requirements on project drawings in order to reduce confusion to designers, reviewers and bidders:

Item	DRWGS	REMARKS
Fire Protection Plan (FPP)	ARCH	
Rated Firewalls	FPP	
Egress System Requirements (NFPA 101)	FPP	
Sprinkler Areas	FPP	Indicated by footnote if entire bldg is sprinklered or show sprinklered areas by cross hatching or zip-a-tone type screening.
Sprinkler System Design	MECH	Show on separate drawing identified as Mech Fire Protection (MFP) Plans
Sprinkler System by Performance Specification		Show hazard classification, seismic zone, type of heads, sprinkler riser, fire dept connection, water flow alarm, drain discharge, demand areas, design density and water supply (test) data on FPP. RFP's require sprinkler systems to be shown on the mech drawings.
Aqueous Film Forming Foam System (AFFF)	MECH	Provide reference note on the FPP. Provide design on MFP plan.
Other Fire Extinguishing Systems	MECH	Provide note on FPP.
Fire Alarm Stations (Pull	ELECT	Show functional layout on fire alarm riser diagram(s). Provide note on FPP.

Boxes)		
Signaling Devices (bell, chimes, gongs, visual alarms, etc.)	ELECT	Show functional layout on fire alarm riser diagram(s). Provide reference note on FPP.
Fire Detection * Devices (heat, smoke, UV, etc.)	ELECT	Show functional layout on fire alarm riser and mech control diagrams. Provide reference note on FPP.
Fire Detection zones (as reqd)	FPP	
Exit Lights	FPP	Provide location reference only.
	ELECT	Detailed location, circulating, scheduling, detailing, etc.
Fire Extinguisher (cabinets)	FPP	
Fire Rated Doors, Frames & Hardware	ARCH DOOR SCHED	Provide reference note on FPP.
	ELECT	Provide reference note on FPP.
Fire Alarm Control Panels	MECH	
Fire Dampers Fire Stopping (for all fire wall penetrations)	MECH (DUCT-WORK) ARCH OTHER PENETR	
	CIVIL	
Post Indicator	CIVIL	
Fire Hydrants		

* For smaller projects, the Fire Detection Devices should be located on the plans; for larger, more complex projects it may be more meaningful to reference the appropriate specifications for these devices. Or, the designer may wish to show the location of smoke detectors such as duct-mounted type on the drawings and reference the specifications for locations of the heat detectors. In any case, careful coordination of the drawings and specifications is required.

CHAPTER 8 - PHYSICAL SECURITY

1. Security engineering design includes measures such as fencing, patrol roads, guard facilities, vehicular barriers, blast standoff and clear zones, Architectural building layout for security, vaults, eavesdropping countermeasures, protective lighting, security systems, locks, arms rooms, entrances, classified material security, surveillance and aggressor entry resistance, blast resistant structural systems, mechanical and electrical systems, ballistics resistance, and retrofit upgrade of existing facilities. Design guidance is in references ER 1110-345-700, Part 2, Chapter 8, TM 5-853-1, TM 5-853-2, and TM 5-853-3, TM 5-853-4.

*2. Identify the assets to be protected, the design threat(s) to these assets, and the level(s) of protection required. Document efforts taken to coordinate with the instillation security plan. List the design criteria. Identify additional criteria needed for final design. Determine if the Protective Design Center of Expertise and Intrusion Detection System Center of Expertise should be used.

*3. The design analysis in this chapter shall be sufficient to identify all the protective measures and procedures required for protection of project assets against their design basis threat. The design of components of the protective measures should be more fully addressed in the design analysis Part 2, Chapters 1 through 6 for the major design disciplines, and cross-referenced herein.

4. The design analysis shall address economy of construction, life-cycle cost effectiveness in accordance with TM 5-802-1.

PART 3 - O&M PROVISIONS.

1. Reference ER 1110-345-700, Part 3, 0&M Provisions).

2. Using Service Responsibilities for O & M. The following are using service responsibilities for O&M that should be considered by the design agency during the design development process:

2.1 Control Responsibilities

2.1.1 Parking allowances and assignment

2.1.2 Pavement and floor loading.

2.1.3 Spare parts, equipment, consumables, and miscellaneous storage.

2.1.4 Energy use

2.1.5 Site access restrictions

2.1.6 Force protection.

2.2 Service Responsibilities

2.2.1 Access-egress maintenance

2.2.2 Landscape maintenance

2.2.3 Snow and ice removal

2.2.4 Housekeeping, trash collection and disposal.

2.2.5 Signage

2.2.6 Mail handling, shipping and receiving

2.2.7 Food service and supply

2.2.8 Health and sanitation

2.2.9 Reproduction (copy) service

2.2.10 Vending (state blind agencies and others)

2.2.11 HVAC

2.2.12 Electrical and communication services

2.2.13 Fire protection

2.2.14 Force protection

2.2.15 Shop support

2.2.16 Plumbing systems

2.2.17 Lifts, hoists, cranes, and elevators

2.2.18 Compressed air and vacuum systems

2.2.19 Fuel storage and dispensing systems

2.2.20 Industrial gas systems

2.2.21 Treatment facility operation and maintenance

2.2.22 Residuals disposal and manifesting

2.2.23 Permit compliance monitoring

2.2.24 Extraction/injection remediation system maintenance

2.2.25 Worker safety and environmental health

3 Provisions for O&M Enhancement and Cost Reduction. The following are provisions for O&M enhancement and cost reduction that should be considered by the design agency during the design development process:

3.1 Control Related.

3.1.1 Preventive overloading factors

3.1.2 Food service efficiency maximizes (preparation, serving, seating, and dish washing)

3.1.3 HVAC efficiency maximizes (sub- and main plant)

3.1.4 Lighting efficiency maximizes (intensities and switching)

3.1.5 Communications efficiency maximizes

3.1.6 Elevator efficiency maximizes

3.1.7 System expandability and flexibility

3.2 Service Related

3.2.1 Below grade flood protection

3.2.2 Above grade solar, water, and wind protection and resistance

3.2.3 Finish materials, textures and colors

3.2.4 Window washing provisions

3.2.5 Provision for cleaning equipment

3.2.6 Vibration and expansion contraction controls

3.2.7 Energy conservation and pollution control measures

3.2.8 Access to mechanical systems: HVAC, elevators, plumbing, process, and special equipment

3.2.9 Provisions for building and system commissioning and testing, adjusting, and balancing of mechanical, electrical and communication systems

3.2.10 Relamping and lighting relocation

3.2.11 Electrical distribution allowance for future loads

3.2.12 Emergency power system testing, and monitoring power quality

3.2.13 Vandalism resistance

3.2.14 Force protection

3.2.15 Confined space reduction/elimination or identification

3.2.16 Toxic or hazardous pollutant sources and exposure potentials

APPENDIX A

PAVEMENT DESIGN

(Note: See AEIM Chapter XIII, Geotechnical, for pavement design requirements.)

APPENDIX B

FOUNDATION DESIGN ANALYSIS

(Note: See AEIM Chapter XIII, Geothecnical, for foundation design requirements.)

Appendix C

PROJECT PHASING DATA

PHASING DATA FOR _____

PROJECT MANAGER _____

1. UTILITY OUTAGES:

   a. Water, Sewer, Gas

      (1) MINIMUM DAYS OF PRIOR NOTICE _____

      (2) MAXIMUM TIME OF OUTAGE _____

      (3) WEEKENDS ONLY? YES _____ NO _____

      (NOTE: STANDARD PARAGRAPH ON OUTAGES CONTAINS THE STATEMENT THAT "TAPPING WITHOUT OUTAGES SHALL BE ACCOMPLISHED WHERE POSSIBLE, IN ACCORDANCE WITH GOOD COMMERCIAL PRACTICE.")

   b. ELECTRICAL.

      (1) MINIMUM DAYS OF PRIOR NOTICE _____

      (2) MAXIMUM TIME OF OUTAGE _____

      (3) WEEKENDS ONLY? YES _____ NO _____

2. STREET CLOSURES: (EXAMPLE: FOR UTILITY LINE CROSSING)

   a. MINIMUM DAYS OF PRIOR NOTICE _____

   b. NUMBER OF LANES TO BE KEPT OPEN _____

   c. WORK MUST BE ACCOMPLISHED BY TUNNELING? YES__ NO__

3. ANY REQUIRED SEQUENCE OF WORK? _____

4. ANY KNOWN WORK RESTRICTIONS? _____

   a. JOINT OCCUPANCY RESTRICTIONS _____

   b. WORKING HOUR RESTRICTIONS_____

c. SECURITY RESTRICTIONS _____

d. ACCESS RESTRICTIONS _____

e. NOISE LEVEL RESTRICTIONS _____

f. OTHER RESTRICTIONS _____

5. ANY REQUIRED BENEFICIAL OCCUPANCY DATES OR PROJECT COMPLETION DATES?

6. USERS DAILY ACTUAL DAMAGE IF BOD IS NOT MET, WITH DOCUMENTATION.

7. ARE THERE ANY SPECIAL FABRICATIONS OPERATIONS OR ITEMS OF GOVERNMENT-FURNISHED EQUIPMENT?

8. ARE THERE ANY ASBESTOS CONTAINING MATERIALS IN LOCATIONS WHERE CONTACT WORK IS TO BE PERFORMED? YES _____ NO _____

IF THE ANSWER TO THE ABOVE QUESTION IS YES, HAS AN INDUSTRIAL HYGIENE ASBESTOS SURVEY OF THE CONTRACT WORK AREA BEEN CONDUCTED AND AN ASBESTOS SURVEY REPORT PREPARED? YES___ NO___

IF AN ASBESTOS SURVEY REPORT HAS BEEN PREPARED, REQUEST YOU ATTACH A COPY TO THIS FORM. QUESTIONS 3-6. IF COMPLEX, WRITE IN "COORDINATION REQUIRED". IF UNKNOWN, WRITE IN "UNKNOWN". IF THE RESPONSE IS CONTINUED ON THE BACK OF THIS SHEET OR ATTACHED SHEET, PLEASE SAY SO.

Appendix D

CHECKLIST OF ITEMS GOVERNING DESIGN
FOR THE PHYSICALLY HANDICAPPED

FOR USE IN PROJECT DESIGN AND DESIGN REVIEW

PROJECT NUMBER _____ TYPE OF FACILITY _____

LOCATION _____

_____

OPEN TO PUBLIC: YES___ NO___ ESTIMATED NUMBER OF VISITORS_____

DESTINATIONS: _____

CIVILIAN OPERATING PERSONNEL: YES___NO___ESTIMATED NUMBER:___

TYPES OF FUNCTIONS THEY WILL PERFORM: _____

_____

ESTIMATED NUMBER OF PARKING SPACES: VISITOR____STAFF____OTHERS

---

*MARK YES OR NO FOR ITEMS WHICH FOLLOW AS APPROPRIATE, OR WRITE N/A UNDER "NO" FOR NON-APPLICABLE.

	YES*	NO*
1. Identifications of Accessible Facilities.		
a. Areas and features identified by International Symbol	____	___
b. Proper specification of International Symbol	____	___
c. Proper location of the symbol, between 815 mm to 1065 mm high	____	___
d. Adequate directional and supplemental information	____	___

		YES*	NO*
2.	Identification for the Visually Handicapped.		
	a. Facilities identified by sight and touch signs	____	___
	b. Proper specification of signs	____	___
	c. Lighted inside, and outside in areas accessible after dark	____	___
	d. Proper location of signs, between 1015 mm and 1320 mm high	____	___
	e. Raised lettering for interpretative material	____	___
	f. Tactile door hardware to identify hazards	____	___
	g. Textured warning strips at head of stairs and ramps	____	___
	h. Proper specification of elevator arrival signals, controls, and call buttons	____	___
	I. Raised numbers on inner-facing elevator door jambs	____	___
3.	Signals for Persons with Auditory Handicaps.		
	a. Elevator signals to visually identify arrival of cars	____	___
	b. Warning signals with visual as well as audible devices	____	___
4.	Site Design.		
	a. Access to at least one primary entrance	____	___
	b. Access to outdoor areas used by general public	____	___
	c. Grading to attain level access and egress to and from entrance	____	___

	YES*	NO*
Site Design. (Continued)		
d. Directional signs at major points of entry to the site	____	___
e. Access-egress routes lighted to 55 lux if used after dark	____	___
f. Accessible toilets, water dispensers, and phones where such facilities are provided in public areas	____	___
g. Solutions with minimal impact on environmental features	____	___
h. Proper location of interpretative displays	____	___
5. Drop-off and Pick-up Zones.		
a. One zone provided where high rate of pedestrian traffic will occur	____	___
b. Zone within 15 meters maximum of a primary entrance	____	___
c. Zone width 300 mm, length for one car minimum, level except for drainage	____	___
d. Vertical posts to separate functions, or at least one curb-ramp	____	___
e. Sign to limit use to pedestrian functions	____	___
6. Parking spaces		
a. One space in areas having up to 20, one additional space for each 50 additional spaces or increment	____	___
b. Spaces within 30 meters of one accessible entrance	____	___
c. Space wait, on common level except for drainage	____	___

Parking spaces (Continued)	YES*	NO*
d. Access to walk does not go behind parked cars or across driveway	____	___
e. Wheel stops to separate functions, or one curb-ramp per car	____	___
f. 1.8 meter clear walkway in front of parked cars	____	___
g. Spaces identified and reserved with signs above ground	____	___
7. Curb-Ramps.		
a. Provided where walks and curbs are being constructed or reconstructed in accessible areas	____	___
b. 1.5 meter wide with slope of 1-in-12, blending to common level with street and walk	____	___
c. Sides flared with slope approximating 1-in-12	____	___
d. 1.2 meter clear walkway at head clear of obstructions	____	___
e. Properly located at street inter-sections and elsewhere to assure safety	____	___
f. Marked cross-walk and traffic warn-ings to ensure unobstructed passage	____	___
g. Firm, non-slip surface	____	___
8. Walks.		
a. Provided for access and agrees to and from usable entrances	____	___
b. 1.8 meter wide with slope no greater than 1-in-24 blending to common level with other surfaces	____	___

Walks. (Continued)	YES*	NO*
c. Continuous surface uninterrupted by abrupt changes	____	___
d. 1.8 by 1.8 meter level rest areas at 18 meters intervals when slopes exceed 1-in-30	____	___
e. At doorways, 1.8 by 1.8 meter level landing extending 460 mm beyond strike jamb	____	___
f. Fixed, firm, and non-slip surfaces, crowned for drainage	____	___
g. If grates are used, no openings between bearing bars greater than 9.5 mm with bars set perpendicular to path of travel	____	___
h. Ground surface graded to walk and compacted to prevent drop-off	____	___
I. Guards where grounds drop off or recede at greater than 1-in-6 slope	____	___
j. Lighting, signs, and other elements set back at least 300 mm	____	___
k. Landscape elements planted to allow 300 mm clearance on side, 2 meters vertical clearance	____	___
l. Adjacent rest areas where walks exceed 60 meters in length	____	___
9. Ramps.		
a. Provide where changes in level exceed allowable slope for walks	____	___
b. 1.8 meters wide with slope no greater than 1-in-12 blending to common level with landings	____	___
c. 1.8 by 1.8 meter level landing at top and bottom	____	___

Ramps. (Continued)	YES*	NO*
d. Like landings at 9 meters intervals for rest and safety	_____	_____
e. At doorways 1.8 by 1.8 meter level landing extending 460 mm beyond strike jamb	_____	_____
f. Fixed, firm, and non-slip surfaces with adequate drainage	_____	_____
g. Protection for ramps exposed to freezing weather	_____	_____
h. Textured or color surface to aid identification in addition to warning strips	_____	_____
10. Stairs.		
a. Provided in addition to ramps (preferred)	_____	_____
b. Minimum 1.2 meter wide with no less than 3 consecutive riser	_____	_____
c. 1.8 meter maximum rise between landings, 1.2 meter where exposed to the elements and unprotected	_____	_____
d. Risers between 125 mm and 175 mm, treads between 430 mm and 280 mm	_____	_____
e. Proportions uniform throughout any one stair	_____	_____
f. Solid risers or risers with nosing having 45 degrees bevel below	_____	_____
g. Non-slip nosing of contrasting color, 25 mm wide on both riser and tread edge	_____	_____
h. Treads exposed to weather pitched for drainage	_____	_____
I. Protection for stairs exposed to freezing weather	_____	_____

		YES*	NO*
11.	Guards and Handrails.		
	a. Guards 1070 mm high along open-sided floor or walk areas	_____	___
	b. Guards 815 mm high along open-sided stairs and ramps	_____	___
	c. 100 mm high curbs in open guards with intermediate filler to prevent fall-through	_____	___
	d. View ports in solid guards 760 mm to 1000 mm high	_____	___
	e. Handrails on both sides of ramps and stairs, 815 mm to 865 mm high	_____	___
	f. In outdoor areas, handrails on at least one side where ramps and stairs have no drop-off on sides	_____	___
	g. Intermediate handrail for children	_____	___
	h. Handrails extended 460 mm beyond top and bottom of stair or ramp at 915 mm high where possible	_____	___
	i. Round or oval handrails, 32 mm to 38 mm outside diameter with 40 mm clear between wall or guard	_____	___
	j. Handrails terminate into wall, guard or newel	_____	___
	k. Handrails mounted to withstand 890 Newton applied in any direction	_____	___
12.	Trails.		
	a. Trails made accessible where provided for for general public	_____	___
	b. Warning signs and level turn-a-round space where hazards cannot be avoided	_____	___
	c. Loop-back and level terrain used		
	d. Access identified at head of trail with directional information along route	_____	___

		YES*	NO*
13.	Building Design.		
a.	At least one primary entrance accessible	_____	_____
b.	Other entrances accessible (preferred)	_____	_____
c.	Identification of all entrances (and exits) or signs to indicate location of accessible entrance	_____	_____
d.	Elevator, when provided, accessible from entrance	_____	_____
e.	Toilets, drinking water dispensers, and phones near entrances and assembly areas	_____	_____
f.	Spaces open to the public designed to accommodate the handicapped	_____	_____
g.	Accessible work stations based on function to be performed	_____	_____
h.	Directional information with primary entrance to locate accessible areas and features	_____	_____
14.	Doors and Doorways.		
a.	Minimum door width, 914 mm (36")	_____	_____
b.	Maximum push-pull on exterior doors of 65 Newton; interior 22 Newton	_____	_____
c.	4-6 second closing delay for automatic operators used to compensate for high pressures	_____	_____
d.	Level-type handles or horizontal push bars centered 915 mm to 1065 mm high	_____	_____
e.	Vision panels with bottom 915 mm above floor when provided	_____	_____
f.	400 mm kickplates on doors or materials to withstand abuse	_____	_____

		YES*	NO*
g.	Door pulls on doors without self-closing devices	_____	_____
h.	Level floor, extending 1.8 meter on pull side, 1.2 meter on opposite side	_____	_____
i.	Level floor extending 460 mm beyond strike jamb on pull side	_____	_____
j.	Series doors 2 meters apart, minimum	_____	_____
k.	6.5 mm maximum threshold on exterior, eliminated where possible on interior	_____	_____
l.	Doormats no more than 6.5 mm high, grate bearing bar openings 9.5 mm maximum, set perpendicular to path of travel	_____	_____

15. Corridors, Floors, and Lobbies.

a.	Corridor width, 1525 mm clear	_____	_____
b.	Lobbies large enough to allow maneuverability	_____	_____
c.	Corridors free of protruding hazards	_____	_____
d.	Floors on common level or connected by ramps and stairs blending to a common level	_____	_____
e.	Ramps, stairs, and railings in accordance with respective criteria	_____	_____
f.	Proper specification of carpet, when used	_____	_____
g.	Information/checkout counters 890 mm high; writing counters 790 mm high	_____	_____
h.	Lock boxes between 460 mm and 1220 mm high with space in front	_____	_____
i.	Proper location of interpretative material	_____	_____

		YES*	NO*
16.	Toilet Rooms		
	a. One room for each sex on each applicable floor	_____	_____
	b. No travel in excess of 45 meters with directional information	_____	_____
	c. Vestibule clearance for wheelchair passage	_____	_____
	d. Floor level with corridor	_____	_____
	e. One toilet compartment to accommodate wheelchair inside with door closed	_____	_____
	f. Out-swinging door no less than 813 mm (32") wide (864 mm (34") preferred)	_____	_____
	g. 1.2 meter between front of compartment and opposite wall	_____	_____
17.	Drinking Water Dispenser.		
	d. Dispensers centered in alcove; 1.8 meters wide for side approach, 915 mm wide for frontal	_____	_____
	e. Up-front spouts and controls, hand-operated	_____	_____
18.	Public Telephones.		
	a. One accessible phone with hearing aid where phones are provided	_____	_____
	b. Volume control or inductive coil in receiver with instructions	_____	_____
	c. 815 mm to 914 mm cord, push-button dial	_____	_____
	d. Highest operating mechanism, 1.2 meters above floor, maximum	_____	_____
	e. 610 mm clear of restriction on each side	_____	_____
	f. Alcoves 1.2 meter deep, 1.2 meter wide with 864 mm (34")door or opening width	_____	_____

		YES*	NO*
19.	Elevators.		
	a. One elevator for 2 or more operating levels used by public	_____	_____
	b. Stop within 6.5 mm to 12.5 mm maximum of facility floor levels	_____	_____
	c. Cab 1525 mm deep, 1725 mm wide with handrails at 915 above floor	_____	_____
	d. Door clear opening, 915 mm (36") minimum, 6 to 10 second closing delay with safety reversing devices	_____	_____
	e. Cab controls between 760 mm and 1370 mm high; emergency call box no higher than 1015 mm	_____	_____
	f. Lobby call buttons 1.2 meter high, maximum	_____	_____
	g. Symbol, sight-touch identification, and signals in accordance with criteria	_____	_____
20.	Switches and Controls.		
	a. Switches and controls between 1015 mm and 1220 mm above floor	_____	_____
	b. Same as above for thermostats and fire alarms in areas subject to handicapped use	_____	_____
	c. Controls operable by 35 Newton force, maximum	_____	_____
	d. Electrical outlets and adjustable vents 460 mm above floor, minimum	_____	_____
21.	Assembly Seat Accommodations.		
	a. One wheelchair space and one wide seat in areas having up to 20; one additional space and seat for each 60 additional seats or increment	_____	_____
	b. Additional spaces in high-use area	_____	_____

	YES*	NO*
c. Integral part of assembly area floor plan with choice of viewing positions	_____	_____
d. Wheelchair spaces 865 mm wide, 1920 mm deep, on level floors with access	_____	_____
e. Seats 610 mm wide with 710 mm clear in front for persons with crutches or braces	_____	_____
f. Tables, 790 mm high overall, 750 mm clear underneath extending 610 mm deep by 915 mm wide	_____	_____
g. Identification of designated handicapped space keyed to directional sign at entrance	_____	_____
22. Dining Areas.		
a. Passage lanes, 1070 mm clear through food service area with 1525 mm square turn-a-round spaces	_____	_____
b. 1.8 meter passage lanes between table without chairs	_____	_____
c. Display shelves and dispenser within reach, tray slide at 865 mm maximum	_____	_____
d. Dining area spaces provided on minimum basis prescribed for assembly areas	_____	_____
e. Tables 950 mm clear underneath for use by everyone	_____	_____
f. Identification of accessibility and sign describing features in food service and dining area	_____	_____
23. Shop and Craft Areas.		
a. Work tables 950 mm clear underneath	_____	_____
b. Passage lanes 1070 mm clear of projections	_____	_____

YES* NO*

c. Work space between parallel tables, 1525 mm wide _____ _____

d. Additional requirements investigated _____ _____

24. Library and Office Areas.

a. 1070 mm passage lanes between book stacks or files with 1525 mm square turn-a-round spaces at aisle ends _____ _____

b. Major passage lanes, 1525 mm wide _____ _____

APPENDIX E

QUALITY CONTROL PLAN

(Note: AE’s Quality Control Plan for design work performed under contract with District or product engineering QCP for design performed by District in-house personnel.)